Notice of Allowability	Application No.	Applicant(s)	
	10/750,169	SADOWSKY, JOHN S.	
	Examiner	Art Unit	
	Sam K. Ahn	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *05/21/07*.

2. ☒ The allowed claim(s) is/are *1-12,14-21 and 23-30, renumbered as 1-28, respectively*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

Patent Examiner 7/23/07

IN THE CLAIMS

Please amend the claims as follows:

1. (Currently Amended) A method for demapping symbols comprising:

performing a first elemental search over a highest-order elementary modulation on a received signal vector that includes multiple elements, wherein the first elemental search is performed within a first search space and produces an identified vector of elementary modulation symbols;

transforming the received signal vector to a new origin that corresponds to the identified vector, resulting in a transformed, received signal vector; [[and]]

performing a subsequent elemental search on the transformed, received signal vector, wherein the subsequent elemental search is performed within a reduced search space defined by the identified vector, and wherein the subsequent elemental search produces a next identified vector of elementary modulation symbols; and

producing demapped bit values that correspond to a next identified vector of elementary modulation symbols of a lowest-level search.

2. (Original) The method of claim 1, wherein the received signal vector is modulated using quadrature amplitude modulation, and quadrature phase shift keying is an elementary modulation.

3. (Original) The method of claim 1, wherein the received signal vector is modulated using pulse amplitude modulation, and binary phase shift keying is an elementary modulation.

4. (Currently Amended) A method for demapping symbols comprising:

performing a first quadrature phase shift keying (QPSK) search on a received signal vector that includes multiple elements, wherein the first QPSK search is performed within a first search space and produces an identified QPSK vector;

transforming the received signal vector to a new origin that corresponds to the identified QPSK vector, resulting in a transformed, received signal vector; [[and]]

performing a subsequent QPSK search on the transformed, received signal vector, wherein the subsequent QPSK search is performed within a reduced search space defined by the identified QPSK vector, and wherein the subsequent QPSK search produces a next identified QPSK vector; and

producing search results that include de-mapped bit values corresponding to a QPSK vector identified as a result of a lowest-level search.

5. (Original) The method of claim 4, further comprising:

producing the received signal vector, wherein each of the multiple elements corresponds to a signal received by one of multiple receive antennas of a multiple-input multiple-output receive antenna array.

6. (Original) The method of claim 4, further comprising:

scaling the transformed, received signal vector, prior to performing the subsequent QPSK search.

7. (Original) The method of claim 4, further comprising:

until the subsequent QPSK search results in a next identified QPSK vector that corresponds to a constellation point,

repeating transforming the transformed, received signal vector; and

repeating performing the subsequent QPSK search.

8. (Original) The method of claim 4, further comprising:

incorporating a tree-searching algorithm into either or both the first QPSK search and the subsequent QPSK search to produce multiple identified QPSK vectors that are used to define the reduced search space.

9. (Currently Amended) The method of claim 8, wherein incorporating the tree-searching algorithm comprises:

incorporating a ~~an M-algorithm~~ tree search into a QPSK search in which a number of the identified QPSK vectors with smallest Euclidian distance values are included in the reduced search space for a subsequent iteration.

10. (Currently Amended) The method of claim 8, wherein incorporating the tree-searching algorithm comprises:

incorporating a ~~T-algorithm~~ tree search into a QPSK search in which a number of the identified QPSK vectors with Euclidian distance values that fall with a threshold of a best of the identified QPSK vectors are included in the reduced search space for a subsequent iteration.

11. (Original) The method of claim 4, further comprising:

producing search results that include at least one soft decision for use by a decoder.

12. (Original) The method of claim 11, wherein producing the search results comprises:

producing the at least one soft decision as a set of log-likelihood ratios or approximations of log-likelihood ratios.

13. (Cancelled)

13 14. (Original) A method comprising:

performing a first quadrature phase shift keying (QPSK) search on a received signal vector, **Y**, which includes multiple elements, wherein the first QPSK search is performed within a first search space and produces an identified QPSK vector; and

until a reduced search space corresponds to a QPSK constellation,

canceling higher-order interference based on the identified QPSK vector and scaling the multiple elements within the received signal vector according to $\tilde{\mathbf{Y}}_k = \frac{1}{2}\left(\tilde{\mathbf{Y}}_{k-1} - \hat{\mathbf{x}}_{k-1}\right)$, where $\tilde{\mathbf{Y}}_k$ is a scaled version of the received signal vector at search level k, and $\hat{\mathbf{x}}_k$ is a QPSK vector at search level k, and

performing a level-k QPSK search according to $\hat{\mathbf{x}}_k = \underset{QPSK\ vectors\ \mathbf{x}}{\arg\min} \left\| \tilde{\mathbf{Y}}_k - \mathbf{H}\mathbf{x} \right\|^2$, where **H** is a channel transfer matrix, and **x** is a transmit signal vector.

14 15. (Original) The method of claim 13 14, further comprising:

incorporating a tree-searching algorithm into either or both the first QPSK search and the level-k QPSK search to produce multiple identified QPSK vectors that are used to define the reduced search space.

15 16. (Original) The method of claim 13 14, further comprising:

producing search results that include at least one soft decision for use by a decoder.

16 17. (Original) The method of claim 15 16, wherein producing the search results comprises:

producing the at least one soft decision as a set of log-likelihood ratios or approximations of log-likelihood ratios.

17 18. (Original) The method of claim 13 14, further comprising:

producing search results that include de-mapped bit values corresponding to a QPSK vector identified as a result of a lowest-level search.

18 19. (Currently Amended) A computer-readable medium having computer program instructions stored thereon ~~to perform a method~~ which, when executed within a multiple-input multiple-output device, results in:

performing a first quadrature phase shift keying (QPSK) search on a received signal vector that includes multiple elements, wherein the first QPSK search is performed within a first search space and produces an identified QPSK vector;

transforming the received signal vector to a new origin that corresponds to the identified QPSK vector, resulting in a transformed, received signal vector; and

performing a subsequent QPSK search on the transformed, received signal vector, wherein the subsequent QPSK search is performed within a reduced search space defined by the

identified QPSK vector, and wherein the subsequent QPSK search produces a next identified QPSK vector; and

producing search results that include de-mapped bit values corresponding to a QPSK vector identified as a result of a lowest-level search.

19 20. (Currently Amended) The computer-readable medium of claim 18, wherein execution of the instructions ~~performing the method~~ further results in:

incorporating a tree-searching algorithm into either or both the first QPSK search and the subsequent QPSK search to produce multiple identified QPSK vectors that are used to define the reduced search space.

20 21. (Currently Amended) The computer-readable medium of claim 18, wherein execution of the instructions ~~performing the method~~ further results in:

producing search results that include at least one soft decision for use by a decoder.

22. (Cancelled)

21 23. (Original) An apparatus comprising:

multiple receive antennas operable to receive multiple received signals; and

a symbol-processing element, operable to

perform a first quadrature phase shift keying (QPSK) search on a received signal vector that includes multiple elements corresponding to the multiple received signals, wherein the first QPSK search is performed within a first search space and produces an identified QPSK vector;

transform the received signal vector to a new origin that corresponds to the identified QPSK vector, resulting in a transformed, received signal vector; and

perform a subsequent QPSK search on the transformed, received signal vector, wherein the subsequent QPSK search is performed within a reduced search space defined by the identified QPSK vector, and wherein the subsequent QPSK search produces a next identified QPSK vector.

22 24. (Original) The apparatus of claim 21, wherein the symbol-processing element is further operable to:

incorporate a tree-searching algorithm into either or both the first QPSK search and the subsequent QPSK search to produce multiple identified QPSK vectors that are used to define the reduced search space.

23 ~~25~~. (Original) The apparatus of claim ~~23~~ 21, wherein the symbol-processing element is further operable to:

produce search results that include at least one soft decision for use by a decoder.

24 ~~26~~. (Original) The apparatus of claim ~~23~~ 21, wherein the symbol-processing element is further operable to:

produce search results that include de-mapped bit values corresponding to a QPSK vector identified as a result of a lowest-level search.

25 ~~27~~. (Original) A multiple-input multiple-output communication device, comprising:

multiple receive antennas operable to receive multiple received signals; and

a symbol-processing element, operable to

perform a first quadrature phase shift keying (QPSK) search on a received signal vector that includes multiple elements corresponding to the multiple received signals, wherein the first QPSK search is performed within a first search space and produces an identified QPSK vector;

transform the received signal vector to a new origin that corresponds to the identified QPSK vector, resulting in a transformed, received signal vector; and

perform a subsequent QPSK search on the transformed, received signal vector, wherein the subsequent QPSK search is performed within a reduced search space defined by the identified QPSK vector, and wherein the subsequent QPSK search produces a next identified QPSK vector.

26 ~~28~~. (Original) The multiple-input multiple-output communication device of claim ~~27~~ 25, wherein the symbol-processing element is further operable to:

incorporate a tree-searching algorithm into either or both the first QPSK search and the subsequent QPSK search to produce multiple identified QPSK vectors that are used to define the reduced search space.

27 ~~29~~ 25. (Original) The multiple-input multiple-output communication device of claim ~~27~~ 25, wherein the symbol-processing element is further operable to:

produce search results that include at least one soft decision for use by a decoder.

28 ~~30~~ 25. (Original) The multiple-input multiple-output communication device of claim ~~27~~ 25, wherein the symbol-processing element is further operable to:

produce search results that include de-mapped bit values corresponding to a QPSK vector identified as a result of a lowest-level search.